

REMARKS

Claim 4 is pending. Claims 1-3, 5 and 6 are canceled. Claim 4 is amended. The features present in claim 4 as amended are present in the originally filed specification. No new matter is added.

Claim 4 has been amended to more particularly point out and distinctly claim Applicants' invention.

The Invention

In the inspection of solder bumps, the use of a telecentric optical system alone does not provide successful determination of the bump height. This is particularly true with bumps which are formed by reflowing solder. This is due to the fact that brightness varies greatly between bumps depending on the oxidized condition of the bump surface and also depending on the bump shape.

This tendency is of increased significance with smaller bumps and causes serious problems when inspecting narrowly-pitched fine bumps as are used in recent semiconductor devices.

The present invention solves this problem as it is directed to a bump inspection method for inspecting shapes of a plurality of bumps on an inspection object wherein each of said bumps has a planar top portion and the bumps are imparted with a substantially hemispherical shape by reflowing solder. The bump inspection method is directed in particular to bumps in which top portions of all of said bumps of the inspection object are in the same plane.

Claim 4 as amended now includes a shaping step in which the top portions of the bumps are shaped into a planar shape by coining such that the top portions of all of said bumps of the inspection object are in the same plane. The step of shaping the top portion of the bumps by a coining process is described on page 12, line 15 to page 13, line 10.

This feature of the present invention, which provides bumps with the top portions having a uniform brightness, enables the bump height to be successfully determined by using a telecentric optical system.

35 U.S.C. 103 Rejection over Ichihara in view of Michael and further view of Kyo

Claim 4 is rejected under 35 U.S.C. 103 on pages 2 through 4 of the Office Action as being unpatentable over U.S. Patent 6,133,052 to Ichihara in view of U.S. Patent 6,317,513 to Michael and further in view of Japanese Patent Application JP 10032279 to Kyo. Applicants hereby respectfully traverse the rejection of the claims. It is submitted that Ichihara only discloses the optical inspection of bumps. Accordingly, Applicants argue that Ichihara does not recite that the bumps are formed into a substantially hemispherical shape by reflowing of solder and have top portions which are shaped into a planar shape by a coining process.

Accordingly, it is submitted that the Ichihara reference fails to disclose the above-mentioned features and that U.S. Patent 6,317,513 to Michael which the Examiner cited as a secondary reference in the proffered combination of references fails to provide any teaching, suggestion or motivation to arrive at the present invention when combined with the Ichihara reference.

In the rejection in the Office Action, the Examiner admits that the primary reference of Ichihara fails to disclose illuminating an inspection object with a parallel pencil of light vertical to the top portions of the bumps through a telecentric optical system. Therefore, the Examiner cites the Michael reference as allegedly teaching what is not disclosed in the Ichihara reference. It is submitted that the Michael reference is directed to an altogether different method and apparatus which concerns solder paste which is screen printed on printed circuit boards using a stencil. In addition, Applicants argue that the method set forth in Michael of acquiring a pre-image and a post-image is entirely different from that of the present claimed invention and therefore cannot be combined with Ichihara to form the basis for a rejection of the present claims. Accordingly, it is respectfully submitted that the Michael reference does not provide any teaching, suggestion or motivation to provide the invention of Ichihara with a telecentric optical system and therefore, the two references cannot be combined.

On page 3 of the Office Action, the Examiner admits that neither the Ichihara reference nor the Michael reference teaches reflowing solder to form substantially hemispherical shapes and shaping the bumps by a coining process. Japanese Patent Application 410032279 to Kyo is then cited in the Office Action on the grounds that it allegedly would have been obvious to one of ordinary skill in the art to form the bumps into a substantially hemispherical shape and to shape the bumps into a planar shape by a coining process.

Applicants respectfully submit that Kyo cannot be relied upon to reject claim 4 on the grounds that 1) the reference does not concern bump inspection and 2) the coining device 50 of Kyo is not applied to solder bumps. It is respectfully submitted that the method of Kyo does not concern bump inspection methods nor relate to any optical inspection method and therefore there

is no reasonable expectation of success that the process taught in Kyo which would lead one of ordinary skill in the art to arrive at the presently claimed bump inspection method.

Further it is submitted that the coining process of Kyo is not applied to a solder bump but rather Kyo is merely directed to a gold tail 22 exposed above the resin coating layer 13 on substrate 10 which is coined by coining device 50 as seen in Fig. 1(c) on page 9. Moreover, Kyo does not apply the coining of a solder bump and does not relate to any bump inspection. Therefore, it is submitted that Kyo cannot be combined with the Ichihara reference or the Michael reference to serve as a basis for the rejection of the claims of the present invention.

Regarding the 35 U.S.C. 103(a) rejections of the claims in the Office Action, Applicants hereby request reconsideration and withdrawal of the rejection.

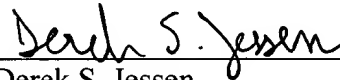
CONCLUSION

For the reasons set forth above, Applicants' present invention, as recited in the amended claims now more clearly and particularly, is patentable. Reconsideration and withdrawal of all outstanding rejections and objections in this case is hereby respectfully requested.

If further matters remain in connection with this case, the Examiner is invited to telephone the Applicant's undersigned representative to resolve them.

In the event that an additional fee is required with respect to this communication, the
Commissioner is hereby authorized to charge any fees, or credit any overpayment, to Paul &
Paul Deposit Account No. 16-0750.

Respectfully Submitted,



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